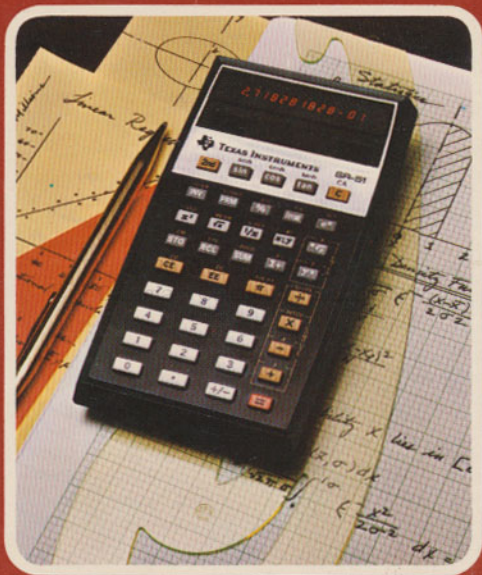


Texas Instruments

super slide-rule calculator
SR-51



OPERATING
GUIDE



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This manual is designed to serve as an easy take-along reference describing step-by-step all the basic operations performed by your SR-51. For a more detailed discussion of complex applications problems, register arithmetic, operating hints and warranty information, please refer to your SR-51 Owner's Manual.

Battery Considerations

- **CAUTION:** Before recharging, check to make sure the battery pack is properly installed in the bottom of the SR-51 and that the switch on the Adapter/Charger is set at the line voltage corresponding to your AC outlet.
- Recharge battery pack when the display flashes erratically or fades out.
- To prolong operating time before the next recharging, press **C** after desired answers have been displayed. Turn your SR-51 OFF when not in use.

Keyboard Operation

Your SR-51 has single function and dual function keys. To execute a function shown on the key, press the desired key. To perform the second function indicated above the key, precede the key depression with **2nd**.

First function operations are indicated by **□**.

Second function operations are indicated by **2nd** **■**.

Flashing Display – Invalid operation. Press **C** to remove.

Calculator Range – $\pm 1. \times 10^{-99}$ to $\pm 9.999999999 \times 10^{99}$.

Switches

On/Off – Located below display window in upper right corner of calculator. Slide to the right to turn calculator ON. Numbers in display indicate that power is ON. Press **2nd** **CA** before proceeding.

D/R – Slide to D if angle entered or calculated is to be expressed in degrees. Slide to R if it is to be expressed in radians.

Data Entry Keys

0 through **9** – Enter numbers 0 through 9.

. – Enters a decimal point.

π – Enters the value of π .

+/- – Changes sign of displayed number when used with mantissa entry. Changes sign of the exponent when pressed after **EE**.

x:y – Exchanges contents of X and Y registers. Used to enter dual arguments for polar-rectangular conversions, decibel conversions and permutations.

Clear Keys

CE – Clears last numeric entry made with **0** - **9** keys in combination with **.**, **+/-** or **EE** keys.

C – Clears current calculation in progress and the display. Contents of memories or location of fixed decimal point are not affected.

2nd **CD** – Clears display only.

2nd **CM** – Clears data in all three memories.

2nd **CA** – Clears all calculator registers, operations and memories.

Second Function Key

2nd – Instructs calculator to perform second function. Cancels second function instruction when pressed twice in succession.

Inverse Function Key

INV – Used prior to trigonometric and hyperbolic functions to calculate inverse functions. Used with list of 20 conversions to reverse order of conversion. Cancels inverse instruction when pressed twice in succession.

Scientific Notation

EE – Instructs calculator to enter the next entry as an exponent of 10. All further results will be displayed in scientific notation until the **C**, **2nd** **CA**, or **2nd** **⌘** **=** keys are pressed.

2nd **⌘** **=** – Instructs calculator to remove both display and calculations from scientific notation when the absolute value of the number is less than 1×10^{10} or greater than 1×10^{-10} .

Mathematical Hierarchy

The mathematical hierarchy establishes the operational precedence of each calculator function. Your SR-51 uses a sum of products precedence. For full details on calculator hierarchy consult your Owner's Manual.

Arithmetic Operations

+ – Instructs calculator to add previous entry or result to the next entry or result.

- – Instructs calculator to subtract next entry or result from the previous entry or result.

X – Instructs calculator to multiply display by the next entered quantity.

÷ – Instructs calculator to divide display by the next entered quantity.

= – Completes the calculations of all algebraic functions. This key is used to obtain both intermediate and final results.

Functions of X

x² – Squares the number displayed.

√x – Takes the square root of the number displayed.
 $X \geq 0$.

1/x – Finds the reciprocal of the number displayed.

$Y \sqrt[x]{Y}$ **X =** – Finds the Xth root of Y. $Y \geq 0$.

$Y y^x$ **X =** – Raises Y to the power X. $Y \geq 0$.

Logarithmic Functions:

lnx – Calculates the natural logarithm of the number displayed. $X \geq 0$.

e^x – Raises e to the power shown in display.

2nd log – Calculates the common logarithm of the number displayed. $X \geq 0$.

2nd 10^x – Calculates the common antilogarithm of the number displayed.

Memory Keys

Your SR-51 has three user accessible memories. All memory related commands **must** be followed by the memory address n (1, 2 or 3).

STO n – Stores display into memory n .

RCL n – Displays data stored in memory n .

SUM n – Algebraically sums display to contents of memory n . Stores result in memory n .

2nd **PROD** n – Multiplies contents of memory n by number displayed. Stores result in memory n .

2nd **EXC** n – Exchanges contents of memory n with the display.

Trigonometric Functions

Trigonometric and inverse trigonometric functions use the D/R switch mode selected when accepting an argument or returning a result. The domain of the inverse sine or cosine function is defined for $-1 \leq y \leq 1$.

sin – Calculates the sine of the angle displayed.

cos – Calculates the cosine of the angle displayed.

tan – Calculates the tangent of the angle displayed.

INV **sin** – Calculates the \sin^{-1} of the number displayed.

INV **cos** – Calculates the \cos^{-1} of the number displayed.

INV **tan** – Calculates the \tan^{-1} of the number displayed.

Hyperbolic Functions

2nd **sinh** – Calculates the hyperbolic sine of the number displayed.

2nd **cosh** – Calculates the hyperbolic cosine of the number displayed.

2nd **tanh** – Calculates the hyperbolic tangent of the number displayed.

INV **2nd** **sinh** – Calculates \sinh^{-1} of the number displayed.

INV **2nd** **cosh** – Calculates \cosh^{-1} of the number displayed.

INV **2nd** **tanh** – Calculates \tanh^{-1} of the number displayed.

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Linear Regression

Your SR-51 performs a least squares linear regression on two-dimensional random variables (x_i, y_i) from a minimum of 2 to a maximum of 99 data points. Always press **2nd** **CA** at start of problem. Always enter x_i value first followed by y_i value. For trend analysis, enter only the y_i values in sequence y_1, y_2, \dots, y_n . Your SR-51 automatically assigns x_i the value i . Because the linear regression routine uses all calculator registers, only functions which operate on the display may be used. Attempts to use any other will cause data loss or will cause display to flash. Press **2nd** **CA** to clear regression routine. The calculated expression for the linear regression curve is:

$$f(x) = y = mx + b$$

2nd **x** – Enters the number displayed as the x coordinate of an (x,y) data point.

2nd **y** – Enters the number displayed as the y coordinate of an (x,y) data point. Forms closed loop on data entry. Number of data points entered thus far appears in display.

2nd **SLOPE** – Displays the slope ,m, of the calculated linear regression curve.

2nd **INTCP** – Displays the Y intercept ,b, of the calculated linear regression curve.

2nd **y'** – Calculates $f(x)$ where x is the value in display and f is the linear regression curve.

2nd **x'** – Calculates $f^{-1}(y)$ where y is the value in display and f is the linear regression curve.

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STATISTICAL FUNCTIONS
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Factorials

2nd **x!** – Calculates the factorial of the number displayed where $0 \leq X \leq 69$, and X is an integer.

Random Numbers

2nd **RAN#** – Generates a two-digit random number from 00 to 99. Each execution of this key sequence will produce a new two-digit random number.

Permutations

n **x:y** **r** **PRM** – Determines the number of permutations of n items taken r at a time, $0 \leq n \leq 69$, $r < n$, n and r integers. This expression is defined as:

$$\text{Perm} \binom{n}{r} = \frac{n!}{(n-r)!}$$

Mean, Variance, Std. Dev.

Press **2nd** **CM** before proceeding. To calculate the mean, variance and standard deviation of data $X_1, X_2, X_3, \dots, X_n$, enter X_1 and press **$\Sigma+$** . The number 1 will appear in the display. Continue for X_2, X_3, \dots, X_n . The numbers 2, 3, ..., n will appear in the display after each successive entry, to indicate the number of data points thus far entered.

$\Sigma+$ – Enters displayed number as data point for calculation of mean, variance and standard deviation.

2nd **$\Sigma-$** – Removes displayed number as data point when calculating mean, variance and standard deviation.

2nd **MEAN** – Calculates mean defined as:

$$\text{Mean} = \bar{X} = \frac{\sum_{i=1}^N X_i}{N}$$

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2nd **S. DEV** **D** – Calculates standard deviation of sample data using N-1 weighting.

$$\text{S.Dev.} = \sqrt{\frac{\sum_{i=1}^N (X_i - \bar{X})^2}{N - 1}}$$

2nd **VAR** – Calculates population variance using N weighting.

$$\text{Variance} = \frac{\sum_{i=1}^N (X_i - \bar{X})^2}{N}$$

To find the standard deviation using N weighting, press **2nd** **VAR** **\sqrt{x}** .

To find the variance using N-1 weighting, press **2nd** **S. DEV** **x^2** .

BUSINESS FUNCTIONS

Fixing the Decimal Point

Calculated results may be displayed with 0 to 8 decimal places. Calculator continues to calculate to 13 decimal-place accuracy internally.

2nd **Fix Pt.** n – Fixes decimal point in calculated results at n decimal places. Fixed point 9 is interpreted as floating point. **2nd** **CL** restores calculator to floating point.

Percentages

% – Converts displayed number from a percentage to a decimal.

+ n **%** **=** – Adds n% to number displayed.

- n **%** **=** – Subtracts n% from number displayed.

X n **%** **=** – Multiplies number in display times n%.

÷ n **%** **=** – Divides number in display by n%.

X_1 **2nd** **Δ%** X_2 **=** – Calculates the percentage change between X_1 and X_2 defined as $\frac{X_2 - X_1}{X_1} \times 100$.

Constant Calculations

The **CONST** key can be used to enter a number as a constant in a **+**, **-**, **X**, **÷**, **y^x**, **^x√y** or **Δ%** operation. Repetitive calculations are completed by entering the variable and pressing **=**.

+ n **2nd** **CONST** – Adds n to each subsequent entry.

- n **2nd** **CONST** – Subtracts n from each subsequent entry.

X n **2nd** **CONST** – Multiplies each subsequent entry by n.

÷ n **2nd** **CONST** – Divides each subsequent entry by n.

y^x n **2nd** **CONST** – Raises each subsequent entry to the power n.

^x√y n **2nd** **CONST** – Takes the nth root of each subsequent entry.

2nd **Δ%** n **2nd** **CONST** – Calculates percent change between n and each subsequent entry defined as

$$\frac{X - n}{n} \times 100.$$

Pressing **C** or entering any of the above functions will clear constant mode operation.

CONVERSIONS

Refer to Table 1.

Basic Conversions (Codes 00 through 16)

n **2nd** code – Converts n number of units in left column to units in center column of table 1.

n **INV** **2nd** code – Converts n number of units in center column to units in left column of table 1.

TABLE 1
Conversion Codes

<u>FROM</u>	<u>TO</u>	<u>CODE</u>
mils	microns	00
inches	centimeters	01
feet	meters	02
yards	meters	03
miles	kilometers	04
miles	nautical miles	05
acres	square feet	06
fluid ounces	cubic centimeters	07
fluid ounces	liters	08
gallons	liters	09
ounces	grams	10
pounds	kilograms	11
short ton	metric ton	12
BTU	calories, <i>gram</i>	13
degrees	grads	14
degrees	radians	15
° Fahrenheit	° Centigrade	16
deg.min.sec.	decimal degrees	17
polar	rectangular	18
voltage ratio	decibels	19

Degrees-Minutes-Seconds/Decimal Degrees Conversions

Always press **2nd** **Fix Pr** 5, 6, 7 or 8. The format for entering degrees, minutes, and seconds is dd.mmss.
dd – Enter number of degrees.

• – Enter **.**

mm – Enter two-digit minutes (00-59).

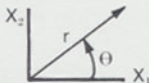
ss – Enter two-digit seconds and decimal fractions of seconds.

dd.mmss **2nd** 17 – Converts degrees, minutes, and seconds to decimal degrees.

n **INV** **2nd** 17 – Converts n number of decimal degrees to degrees, minutes, and seconds.

Polar/Rectangular Conversions

The reference system used for polar/rectangular conversions is as shown:



Position the D/R switch to the angular units desired for both entry and retrieval.

r $\boxed{x:y}$ Θ $\boxed{2nd}$ 18 – Converts polar to rectangular coordinates and displays X_2 coordinate.
 $\boxed{x:y}$ displays X_1 coordinate.

X_1 $\boxed{x:y}$ X_2 \boxed{INV} $\boxed{2nd}$ 18 – Converts rectangular to polar coordinates and displays angle Θ .
 $\boxed{x:y}$ displays r coordinate.

Ratio/Decibel Conversions

The voltage ratio $\frac{X_1}{X_2}$ expressed in decibels is defined as

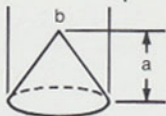
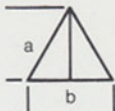
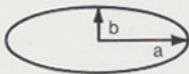
$$20 \log \frac{X_1}{X_2}$$

X_1 $\boxed{x:y}$ X_2 $\boxed{2nd}$ 19 – Converts ratio of $\frac{X_1}{X_2}$ to decibels.

dB \boxed{INV} $\boxed{2nd}$ 19 – Converts dBs to decimal equivalent of a ratio $\frac{X_1}{X_2}$.

Because conversion 18 processes data in the Y and Z registers and 19 processes data in the Y register, any mathematical expression will be erased.

Appendix



Circumference: Circle $2\pi r$

Area: Circle	πr^2
Ellipse	πab
Sphere	$4\pi r^2$
Cylinder	$2\pi r[r+l]$
Triangle	$\frac{1}{2}ab$

Volume: Ellipsoid of revolution	$\frac{4}{3}\pi b^2 a$
Sphere	$\frac{4}{3}\pi r^3$
Cylinder	$\pi r^2 l$
Cone	$\frac{\pi b^2 a}{12}$

Analytical: Circle	$\frac{x^2}{r^2} + \frac{y^2}{r^2} = 1$
Ellipse	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
Hyperbola	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$
Parabola	$y^2 = \pm 2px$
Line	$y = mx + b$

Trigonometric Relations



$$\sin \theta = \frac{y}{r}$$

$$\cos \theta = \frac{x}{r}$$

$$\tan \theta = \frac{y}{x}$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$e^{i\theta} = \cos \theta + i \sin \theta$$

$$i = \sqrt{-1}$$

$$\sinh \theta = \frac{e^{\theta} - e^{-\theta}}{2}$$

$$\cosh \theta = \frac{e^{\theta} + e^{-\theta}}{2}$$

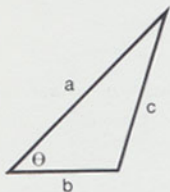
$$\tanh \theta = \frac{e^{\theta} - e^{-\theta}}{e^{\theta} + e^{-\theta}}$$

$$\cosh^2 \theta - \sinh^2 \theta = 1$$

$$e^{\theta} = \sinh \theta + \cosh \theta$$

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Law of Cosines:



$$a^2 + b^2 - 2ab \cos \theta = c^2$$

$$\text{Binomial Distribution} - \frac{n!}{(n-r)! r!} (p)^r (1-p)^{n-r}$$

p = probability of success

n = number of trials

r = number of successes

$$\text{Poisson Distribution} - \frac{e^{-m} m^x}{x!}$$

m = average number of
occurrences per unit
time

x = number of occurrences

$$\text{Gaussian Distribution} - \frac{1}{\sqrt{2\pi} \sigma} e^{\left[-\frac{(x - \bar{x})^2}{2\sigma^2} \right]}$$

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\bar{x} = mean

σ^2 = variance

VALUES OF FUNDAMENTAL PHYSICAL CONSTANTS

Constant	Symbol	Value	Units	
			mks	cgs
1. Speed of Light	C	2.9979250	10^8 msec^{-1}	$10^{10} \text{ cmsec}^{-1}$
2. Electron Charge	e	1.6021917	10^{-19} C	10^{-20} emu
3. Avogadro Number	N	6.022169	$10^{23} \text{ kmole}^{-1}$	$10^{23} \text{ mole}^{-1}$
4. Electron Rest Mass	me	9.109558	10^{-31} kg	10^{-28} g
	me	5.485930	10^{-4} amu	10^{-4} amu
5. Proton Rest Mass	Mp	1.672614	10^{-27} kg	10^{-24} g
	Mp	1.00727661	amu	amu
6. Neutron Rest Mass	Mn	1.674920	10^{-27} kg	10^{-24} g
	Mn	1.00866520	amu	amu
7. Atomic Mass Unit	amu	1.660531	10^{-27} kg	10^{-24} g
8. Ratio of proton to electron rest mass	Mp/me	1836.109	—	—
9. Electron Charge to Mass ratio	e/Me	1.7588028	10^{11} Ckg^{-1}	10^7 emu g^{-1}
10. Planck Constant	h	6.626196	10^{-34} J-sec	10^{-27} erg-sec
11. Rydberg Constant	R_{∞}	1.09737312	10^7 m^{-1}	10^7 cm^{-1}
12. Gas Constant	R_m	8.31434	$10^3 \text{ J-kmole}^{-1} \text{ K}^{-1}$	$10^7 \text{ erg-mole}^{-1} \text{ K}^{-1}$
13. Boltzmann Constant	k	1.380622	10^{-23} JK^{-1}	$10^{-16} \text{ erg K}^{-1}$
14. Gravitational Constant	G	6.6732	$10^{-11} \text{ N-M}^2 \text{ kg}^{-2}$	$10^{-8} \text{ dyn-cm}^2 \text{ g}^{-2}$
15. Electron Volt	eV	1.6021917	10^{-19} J	10^{-12} erg
16. Magnetic Flux Quantum	Φ_0	2.0678538	10^{-15} T-m^2	10^{-7} G-cm^2
17. Bohr Magneton	μ_B	9.274096	10^{-24} JT^{-1}	$10^{-21} \text{ ergG}^{-1}$
18. Electron Magnetic Moment	μ_e	9.284851	10^{-24} JT^{-1}	$10^{-21} \text{ ergG}^{-1}$
19. Proton Magnetic Moment	μ_p	1.4106203	10^{-26} JT^{-1}	$10^{-23} \text{ ergG}^{-1}$
20. Compton Wavelength of the Electron	λ_c	2.4263096	10^{-12} m	10^{-10} cm
21. Compton Wavelength of the Proton	$\lambda_{c,p}$	1.3214409	10^{-15} m	10^{-13} cm
22. Compton Wavelength of the Neutron	$\lambda_{c,n}$	1.3196217	10^{-15} m	10^{-13} cm
23. Faraday Constant	F	9.648670	10^7 Ckmole^{-1}	$10^9 \text{ emu mole}^{-1}$

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